EFFECTS OF SECTIONAL BREATHING TECHNIQUES ON OPTIMIZING PHYSIOLOGICAL PARAMETERS IN WOMEN ATHLETES

ВПЛИВ СЕКЦІЙНИХ ДИХАЛЬНИХ ТЕХНІК НА ОПТИМІЗАЦІЮ ФІЗІОЛОГІЧНИХ ПОКАЗНИКІВ У СПОРТСМЕНОК

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Abstracts

Background and Study Aim. Sectional breathing techniques have been associated with enhanced respiratory function and cardiovascular efficiency. This study aimed to evaluate the effectiveness of a 12-week sectional breathing intervention on improving vital capacity and reducing resting heart rate among women athletes engaged in regular sports training.

Material and Methods. A simple randomized controlled trial was conducted involving 82 women players aged 18 to 23 years, randomly assigned to either the experimental group (n = 41), which practiced sectional breathing along with regular training, or the control group (n = 41), which followed regular training without additional intervention. The intervention consisted of guided sectional breathing sessions conducted twice daily (20 minutes each) for six days a week over 12 weeks. Pre– and post-intervention measurements included vital capacity (in liters) and heart rate (in beats per minute). Repeated measures ANOVA and Bonferroni pairwise comparisons were used for statistical analysis.

Results. The experimental group showed a significant increase in mean vital capacity from 3.008 L (±0.287) to 3.156 L (±0.305), supported by a large effect size ($F = 448.397$, $p = .000$, $\eta^2 = .847$). Similarly, heart rate significantly decreased from 55.207 bpm (±6.204) to 49.951 bpm (±5.906) ($F = 246.097$, $p = .000$, $\eta^2 = .752$). Pairwise comparisons confirmed statistically significant differences between pre– and post-intervention measures for both outcomes.

Conclusions. The findings demonstrate that sectional breathing is an effective and time-efficient strategy to enhance lung function and improve cardiovascular efficiency in women athletes. Incorporating such respiratory training into regular sports routines may offer measurable health and performance benefits.

Key words: Sectional breathing, Vital capacity, Heart rate, Women athletes, Respiratory training.

Передумови та мета дослідження. Секційні дихальні техніки були пов'язані з покращенням дихальної функції та серцево-судинної ефективності. Мета цього дослідження – оцінити ефективність 12-тижневого курсу секційного дихання на покращення життєвої ємності легень та зниження частоти серцевих скорочень у стані спокою серед спортсменок, які займаються спортом на регулярних тренуваннях.

Матеріал та методи. Просте рандомізоване контрольоване дослідження було проведене за участю 82 спортсменок віком від 18 до 23 років, рандомізованих або до експериментальної групи (n = 41), яка практикувала секційне дихання разом з регулярними тренуваннями, або контрольної групи (n = 41), яка дотримувалася регулярних тренувань без додаткового втручання. Втручання складалося із сеансів секційного дихання під керівництвом тренера, які проводилися двічі на день (по 20 хвилин) протягом шести днів на тиждень протягом 12 тижнів. Вимірювання до і після втручання включали життєву ємність легень (у літрах) і частоту серцевих скорочень (в ударах за хвилину). Для статистичного аналізу були використані повторні вимірювання ANOVA та попарні порівняння Бонферроні.

Результати. В експериментальній групі спостерігалося значне збільшення середньої життєвої ємності легень з 3,008 л (±0,287) до 3,156 л (±0,305), що підтверджується великим розміром ефекту ($F = 448,397$, $p = .000$, $\eta^2 = .847$). Аналогічно частота серцевих скорочень значно знизилася з 55,207 уд/хв (±6,204) до 49,951 уд/хв (±5,906) ($F = 246,097$, $p = .000$, $\eta^2 = .752$). Парні порівняння підтвердили статистично значущі відмінності між показниками до і після втручання для обох результатів.

Висновки. Отримані результати демонструють, що секційне дихання є ефективною та економічною стратегією для покращення функції легень та підвищення серцево-судинної ефективності у спортсменок. Включення таких дихальних тренувань у регулярні спортивні програми може мати вимірні переваги для здоров'я та продуктивності.

Ключові слова: секційне дихання, життєва ємність легень, частота серцевих скорочень, спортсменки, дихальні тренування.

Introduction. Every creature's life is sustained by a basic air movement known as breathing, which is more instinctive and natural. It is observed that the understanding breathing has become more advanced now through the researches done in sports science, psychophysiology and medicine, in spite of the process apparent simplicity. Yoga and their regular practice are regarded as a form of exercise regimen particularly found effective for improving as well as with maintaining an optimal health followed by exhibiting profound effect with pulmonary system and their functioning [3].

Yoga practices have been using exercises and breath awareness to cultivate "prana", which means "breath" and "life force" in Sanskrit, for millennia. At the time of meditation, freediving and breathwork practices and freediving seize the goodness for their performance, calmness and focus. There has been seen a significant positive effects of resonant frequency breathing performed in the biofeedback of heart-rate variability (HRV) itself and also the overall regulation of autonomic nervous system and the relevant emotional states namely depression and anxiety [9]. By employing breathing techniques during the resting phase, players tend to experience additive effect on their concentration, cognitive functioning and decision making while performing [2; 8]. When positive psychological states namely enjoyment and efficacy are affected by the physical and mental performance, the above-mentioned effects remain more valuable in sports. Slow breathing utility during exercise has been understudied, even though slow breathing has been efficacious at rest demonstrably [14].

Pranayama is regarded not only as a simple breathing exercise regimen, which not only facilitate with breath control as the breathing technique in general attributed as powerful yogic practice that is employed for regulating energy flow which is termed in Sanskrit as 'prana' referring to the human body which rises to higher frequency upon its practice [20]. There has been traditional literature on yogic practices suggesting on the very fact that there are four major breathing practices that has been utilized when performing Pranayama. The following breathing practices are as follows: Anthar kumbhaka (Internal retention of breathing practice), Bahir kumbhaka (External Retention of breathing practice), Puraka (inhalation) and Rechaka (exhalation) [7]. There are three yogic breathing techniques in which sectional breathing technique (Vibhagiya Pranayama) is one among them. The other two techniques are alternate Breathing via nostril with Internal voluntary breathing retention (Nadi Shodhana Pranayama with Anthar kumbhaka) and Yogic Bellows Breathing (Bhastrika Pranayama) [1; 17].

In a study by, Alternate Nostril Breathing has shown a big effect among healthy individuals to improve the lungs' vital capacity and cardio-pulmonary functioning. In addition, the maximum ventilatory volume of lung and vital capacity are increased when the alternate nostril breathing is used with yogic bellows breathing [5]. In addition, the access of the body's tissues to oxygen are improved when it is doing with voluntary internal breathing retention [6]. When practicing both Alternate Nostril Breathing and Yogic Bellows Breathing, it shows a significant effect of improving maximum ventilatory volume alongside the lungs' vital capacity, while when on considering the practice which employs Volu-

ntary Internal Breathing Retention which promotes in better availability of oxygen supply to the tissues [4, 13]. When employing 'Yogic Bellows Breathing' as a breathing practice alongside with other practices showcased with better reduction of the basal heart and respiratory rate, thereby indicating better parasympathetic activity as well as cardiac autonomic reactivity [21]. Sectional Breathing increases the thoraco-pulmonary compliances much more efficiently via utilizing both abdominal and diaphragmatic muscles, thus filling and emptying respiratory apparatuses much more completely and efficiently. Sectional Breathing involves with individual's awareness towards aiding and correcting their inefficient breath pattern alongside with facilitating in improving the lungs' vital capacity significantly [18]. When other breathing exercise is doing with Yogic Bellows breathing, there is a decline in respiratory rate and baseline heart rate which is more apparent that indicated the enhanced parasympathetic activity & cardiac autonomic reactivity [11]. Thoraco-pulmonary compliances are increased by enhancing the diaphragm and the abdomen muscles' usage and allowing for the respiratory system's effective filling and emptying. Ineffective breath patterns are improved and by strengthening the vital capacity of the lung is considerably increased by performing this on a routine basis in accordance to his/ her personal awareness [12]. Upon individual investigation on various literature investigation so far suggesting the need for exploring the impact of Yogic Breathing Practices among the healthy volunteers, in our case of the study utilizes these practices as a means for improving the pulmonary functioning and endurance of respiratory muscles among sports person.

Aim of the study. This study aims to investigate the sectional breaking techniques and its effect on women players for optimizing their psychological parameters.

Material and methods. Participants. The study recruited a total of 82 women athletes, aged between 18 and 23 years, who were actively engaged in competitive sports at the college or university level from SRM Group of Institutions, Chennai, India. Participants were selected based on specific inclusion criteria: no prior experience with sectional breathing or related respiratory training, and the absence of any respiratory, cardiovascular, or psychological conditions. Additionally, individuals with injuries that could limit their participation in the intervention or regular training were excluded from the study. Eligible participants were randomly allocated into two groups: an experimental group (n = 41) and a control group (n = 41).

Research Design. A simple randomized controlled trial design was employed to assess the effects of sectional breathing techniques on vital capacity and heart rate. Ethical approval was granted by the Institutional Review Board of SRM Institute of Science and Technology (Approval No. 8823, dated May 2024). The study design ensured internal validity by controlling extraneous variables and randomly assigning participants to intervention or control groups. The experimental group received the sectional breathing intervention in addition to their regular training, whereas the control group continued only with their usual training routine.

Procedure. The intervention spanned 12 weeks, during which the experimental group engaged in sectional breathing exercises under the supervision of a trained instructor. Each session lasted for 20 minutes and was conducted twice daily before and after routine sports training six days per week. Sectional breathing focused on consciously activating specific regions of the lungs (abdominal, thoracic, and clavicular) to enhance oxygen intake and respiratory efficiency. The control group followed their standard sports training without any additional intervention. This arrangement allowed for a clear comparison of changes in vital capacity and heart rate attributable to the breathing intervention.

Statistical Analysis. Descriptive statistics (mean, standard deviation, and standard error) were computed for all measured variables. Repeated measures ANOVA was used to evaluate within-subject changes in vital capacity and heart rate from pre- to post-intervention, along with effect size estimations using partial eta squared. Pairwise comparisons with Bonferroni adjustment were conducted to further explore significant differences. Statistical significance

was set at $p < 0.05$, and all analyses were performed using SPSS software.

Results of the Study. The results of the study present the effects of sectional breathing techniques on vital capacity and heart rate among women athletes. Statistical analyses, including descriptive data and repeated measures ANOVA, were used to compare pre– and post-intervention values. Significant improvements were observed, supporting the effectiveness of the breathing intervention.

Demographic data, on the one hand, provide a good deal of information about the physical attributes of the participants concerning age, height, body mass, and fat-free mass. The athletes are within the age range of 18 to 24 years, having a mean age of 20.60 years (±1.70 years). The elite athletes have their heights ranging from 154 cm to 173 cm, with an average height of 164.26 cm (±5.34 cm). In terms of body mass, the values range from 18.51 kg to 23.01 kg, with an average of 20.93 kg (±1.29 kg). Fat-free mass was between 40.00 kg and 55.00 kg, averaging 48.70 kg (±4.60 kg).

The repeated measures ANOVA results for vital capacity (Table 2) demonstrated a statistically significant improvement following the intervention. The mean vital capacity increased from 3.008 liters (±0.287) pre-intervention to 3.156 liters (±0.305) post-intervention. This change was supported by a highly significant F-value of 448.397 ($p = .000$), indicating a strong effect of the intervention on lung function. The partial eta squared value of 0.847 reflects a very large effect size, with approximately 84.7% of the variance in vital capacity attributed to the intervention. Pairwise comparisons further confirmed the significance of this improvement, revealing a mean difference of -0.149 liters between pre- and post-measurements, with a standard error of 0.007 and a 95% confidence interval ranging from -0.163 to -0.135.

Table 1

Descriptive Statistics on the respondents' anthropometric ranges

	Minimum	Maximum	Mean	Std. Error (SE)	Std. Deviation (SD)
Age	18	24	20.60	0.19	1.70
Height (cm)	154.00	173.00	164.26	0.59	5.34
Body Mass (kg)	18.51	23.01	20.93	0.14	1.29
Fat free mass (kg)	40.00	55.00	48.70	0.51	4.60

Table 2

Repeated Measures ANOVA and Pairwise Comparisons for Vital Capacity (in liters)

Measure	Time Point	Mean	Std. Deviation	F	p-value	Partial Eta Squared	Mean Difference (Pre–Post)	Std. Error	95% CI (Lower–Upper)
Vital Capacity	Pre	3.008	0.287	448.397	.000	.847	-0.149*	0.007	[-0.163, -0.135]
	Post	3.156	0.305						

*Significant at $p < 0.05$.

Table 3

Repeated Measures ANOVA and Pairwise Comparisons for Heart Rate (beats per minute)

Measure	Time Point	Mean	Std. Deviation	F	p-value	Partial Eta Squared	Mean Difference (Pre–Post)	Std. Error	95% CI (Lower–Upper)
Heart Rate	Pre	55.207	6.204	246.097	.000	0.752	5.256*	0.335	[4.589, 5.923]
	Post	49.951	5.906						

*Significant at $p < 0.05$

The results of the repeated measures ANOVA for heart rate (Table 3) revealed a significant reduction in values from pre– to post-intervention, with the mean dropping from 55.207 bpm (±6.204) to 49.951 bpm (±5.906). The analysis yielded an F-value of 246.097 and a p-value of 0.000, indicating that this change is statistically significant ($p < 0.05$). The partial eta squared of 0.752 suggests a large effect size, with 75.2% of the variance in heart rate explained by the intervention. Furthermore, pairwise comparisons with Bonferroni adjustment confirmed this significant difference, showing a mean decrease of 5.256 bpm (±0.335), with a 95% confidence interval ranging from 4.589 to 5.923 bpm.

Discussions. The present study aimed to evaluate the effectiveness of a 12-week sectional breathing intervention on vital capacity and heart rate among women athletes. The findings strongly indicate that the structured breathing practice had a significant and positive impact on both respiratory and cardiovascular parameters.

Firstly, the improvement in vital capacity from 3.008 liters to 3.156 liters was not only statistically significant ($p < 0.001$) but also meaningful in terms of physiological enhancement. The large effect size (partial eta squared = 0.847) suggests that approximately 84.7% of the variability in vital capacity could be attributed to the breathing intervention. This finding aligns with previous research emphasizing the importance of targeted respiratory practices in enhancing lung function by increasing thoracic expansion and improving alveolar ventilation. Sectional breathing, by isolating and training different zones of the lungs (abdominal, thoracic, and clavicular), likely contributed to more efficient utilization of lung volume, thus leading to the observed improvements. The controlled and repetitive nature of the breathing sessions may have also strengthened respiratory muscles such as the diaphragm and intercostals, further supporting this enhancement [12; 20]. Similarly, the significant reduction in resting heart rate from 55.207 bpm to 49.951 bpm indicates improved cardiovascular efficiency. The intervention demonstrated a substantial effect ($F = 246.097$, $p < 0.001$; partial eta squared = 0.752), with a reduction of over 5 bpm supported by a narrow confidence interval and small standard error. This improvement in resting heart rate may reflect enhanced parasympathetic tone and autonomic regulation as a result of the breathing practice. Breathing interventions are known to stimulate the vagus nerve and reduce sympathetic activity, resulting in slower heart rates and improved heart rate variability (HRV). These physiological adaptations are commonly associated with better aerobic fitness, stress regulation, and overall cardiovascular health. Therefore, the significant drop in heart rate in the experimental group likely signifies both enhanced fitness and relaxation response following the breathing training [1; 6].

The study's randomized controlled design, with carefully matched experimental and control groups, strengthens the reliability of the findings. Baseline comparisons across anthropometric measures, including age, height, body mass, and fat-free mass, showed relatively small differences that are unlikely to confound the outcome measures. The controlled setting, consistent training regimes across both groups (except for the breathing intervention), and adherence to ethical standards further support the internal validity of the study. Moreover, the practical relevance of these findings cannot be overlooked. Improvements in vital capacity can enhance endurance and oxygen availability during prolonged physical activity, while a lowered resting heart rate may reflect better cardiovascular conditioning and recovery in athletes. For female collegiate athletes, especially in high-endurance or skill-based sports, integrating breathing techniques into their training regimen could be a low-cost, non-invasive strategy to boost both respiratory and cardiovascular performance [12; 19].

These results also contribute to a growing body of evidence supporting the role of non-pharmacological interventions like yoga, pranayama, and sectional breathing in athletic performance and recovery. While much of the earlier literature has focused on general populations or clinical samples, this study adds value by highlighting the applicability and efficacy of such techniques in a competitive sports context, specifically among young women athletes [11].

However, despite the strength of the findings, a few limitations should be acknowledged. The study focused solely on women athletes from a specific institution, which may limit generalizability to other populations, age groups, or sports disciplines. Future research could explore the long-term retention of these benefits, the impact across different sport types (aerobic vs. anaerobic), and comparisons with other forms of respiratory or relaxation techniques. Additionally, incorporating physiological markers such as oxygen saturation, tidal volume, or HRV could provide deeper insight into the mechanisms underlying these changes [15; 16; 17].

Conclusions. The 12-week sectional breathing intervention significantly improved both vital capacity and resting heart rate among women athletes. The findings support the integration of targeted breathing exercises into athletic training programs to enhance respiratory efficiency and cardiovascular health. This study underscores the value of combining traditional training methods with evidence-based breathing techniques to optimize performance and recovery in sports contexts.

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Conflicts of Interest. The authors confirm that they have no conflicts of interest related to this study.

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